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Hazard Identification & Risk Assessment of A 100 Mw Solar Power Plant

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ABSTRACT : Safety, as trivial as it may sound, is one of the most important factors for working at a Solar Power Plant site. In many cases, people at the site are unaware of the specific and generic safety measures to be taken for solar power plant installations which pose significant hazards present which can result in permanent injury or death. It is important to ensure that work happens safely and effectively to prolong the life of the system and ensure the well-being of the workers operating the system. Everyone entering a solar farm, for whatever reason, should have been trained in the dangers present on solar farms and be trained for the individual task that they will be performed. They should have all of the PPE and tools necessary to carry out the work in the safest way possible. The work should be planned in advance and everyone concerned should have a common understanding of all aspects related to the safe execution of their task.

Risks can be mitigated through proper hazard identification, careful planning of works, briefing of procedures to be followed regular and well documented inspection and maintenance. For that it is highly required to conduct a proper hazard identification and corresponding Risk assessment (HIRA) to evaluate the risks associated to find out proper mitigation plan and management programs. The output of a proper HIRA will be Safe Operating Procedures or Operational control Procedures and Safety Management Programs. Conducting a complete and systematic HIRA at a large sized 100 MW Solar PV Power plant covering most of the Operations & Maintenance functions and documenting the same is taken as a Project.

I.INTRODUCTION

1. Solar plants are electricity generating power stations and pose significant hazards present which can result in permanent injury or death.
2. Everyone entering a solar farm, for whatever reason, should have been trained in the dangers present on solar farms and be trained for the individual task that they will be performed. They should have all of the PPE and tools necessary to carry out the work in the safest way possible. The work should be planned in advance and everyone concerned should have a common understanding of all aspects related to the safe execution of their task. Different countries will mandate written and hard copy paperwork to meet legislation, but best practice is to exceed the minimum requirements and to embrace the spirit of all relevant legislation.
3. Risks can be mitigated through proper hazard identification, careful planning of works, briefing of procedures to be followed regular and well documented inspection and maintenance.
4. For that it is highly required to conduct a proper hazard identification and corresponding Risk assessment (HIRA) to evaluate the risks associated to find out proper mitigation plan and management programs.
5. The output of a proper HIRA will be Safe Operating Procedures or Operational control Procedures and Safety Management Programs.
6. Conducting a complete and systematic HIRA at a large sized 100 MW Solar PV Power plant covering most of the Operations & Maintenance functions and documenting the same is taken as a Project.

II. METHODOLOGY

2.1 STEPS INVOLVED IN HAZARD IDENTIFICATION AND RISK ASSESSMENT

2.1.1 Identification of the Hazard

Hazard Identification is a critical step in Risk Analysis. Many aids are available, including experience, engineering codes, checklists, detailed process knowledge, equipment failure experience, hazard index techniques, What-if Analysis, Hazard and Operability (HAZOP) Studies, Failure Mode and Effects Analysis (FMEA), and Preliminary Hazard Analysis (PHA). In this phase all potential incidents are identified and tabulated. Site visit and study of operations and documents like drawings, process write-up etc are used for hazard identification.

2.1.2 Assessment of the Risk

Consequence Estimation is the methodology used to determine the potential for damage or injury from specific incidents. A single incident can have many distinct incident outcomes. Likelihood assessment is the methodology used to estimate the frequency or probability of occurrence of an incident. Risks arising from the hazards are evaluated for its tolerability to personnel, the facility and the environment. The acceptability of the estimated risk must then be judged based upon criteria appropriate to the particular situation. Risk Matrix has been used for assessing the risks. Figure 9 demonstrates the Risk Matrix.

2.1.3 Defining Risk Priority Number

RPN is a numeric assessment of risk assigned to a process, or steps in a process considering its Severity, Occurrence and Detection scale of gradation.

The scoring system typically used for severity, probability of occurrence, and probability of detection is generally from 1 to 10, with 1 considered low risk and 10 high risk.

The RPN score is calculated by multiplying the severity/criticality, probability of occurrence, and probability of detection.

RPN = Severity x Occurrence x Detection

III. LITERATURE REVIEW

Many literatures like Books, e Journals, Websites, and Reports have been referred and reviewed in support of my project preparation. The following are the outcome and take away from those references.

First, Reference Material of Hazard Identification & Risk Assessment Procedure of SEI Cleantech Pvt Ltd. has been reviewed and its source Format is Documented Manual. Title of the document is **“Procedure for Environmental Aspects, Hazard Identification Risk Assessment and Control”**. This document is prepared and maintained by the Department of Health, Safety and Environment of SEI Cleantech Pvt Ltd

A controlled copy of Standard operating Procedure of SEI Cleantech Pvt Ltd for “Procedure for Environmental Aspects, Hazard Identification Risk Assessment and Control” manual SEIC_OM_P_HSE008 - Rev 03 dated 11072021 is used as a primary reference for this Risk Assessment project. This Procedure provided the Scope and steps involved in a thorough risk assessment process. Mainly it provides the RISK MATRIX followed by the company for both Environmental Aspects and Health and Safety Hazards.

Table-1. Proposed control measures

Hazard category and hazard	Who might be harmed and how?	What are you already doing?	What further controls/actions are required?	Timescale for further actions	Responsible person's job title
3) Hazard Category : Fire Hazard: Fire like Dry grass fire starting from the activities such as Welding works, and other Hot works like cutting, Smoking. Fire from a Faulty Electrical Equipment, Handling Flammable Oils like transformer Oil etc.,	All workers involving periodical Maintenance activity are prone to burn injury, Smoke inhalation. The people who are transporting Transformer Oil & Gas Cylinders are subject to be affected with this hazard.	1. Following Hot Work Permit System.	1. Providing 'Fire Safety & Preparedness and management of Fire hazard' Training to 100% of employees.	2 Months	Area O&M Manager
		2. Flammable or combustible materials will be removed from working area.	2. Ensuring the availability and working condition of Fire Extinguishers inside Control Room,	2 Weeks	Maintenance In-Charge
		3. Supervisory Control is in work place.	3. Installation of Suitable Fire Extinguishers in Hot work area in and around wind turbine.	1 week	Maintenance Team Leader
		4. Proper PPEs like Safety Shoes, Safety Helmet, and Welding gloves, Face Shield or Goggles.	4. Fire Blankets have to be made ready before hot works which are being carried out near dry grasses.	2 weeks	Maintenance Team Leader
		4. Only Trained employees are permitted to perform hot works.			
		5. Ensuring hot work area is free from flammable materials.			

IV. RESULTS OF EXPERIMENTAL PRACTICES

4.1 Implementation of Control Measures recommended against Arc Flash

To get the Electrical Flash over hazard under control, we recommended the following things based on the Hazard Identification and Risk Assessment practice.

- 1) Isolation of Power to be insisted. Working in a Live Panel should be strictly prohibited. For that, SAFE WORK PERMIT SYSTEM has been made stringent to be followed. The Section In-charge who is available in that particular shift will sign in the SWP, only after confirming the Isolation of Power. Thus, working in a live panel is prevented.

2) Purchasing & ensure Wearing HRC 4 rated Arc Flash Prevention Suit & rated Electric resistant Hand Gloves. Procuring a Set of Arc Flash prevention Suit HRC and using the same while doing Activities which are prone to Arc Flash is the next recommendation.

Here, there are two types of Arc Flash Suits available. They are HRC2 and HRC4. According to NFPA 70E, HRC2 Suits are suitable for less than 8 kCal/sqcm. Whereas HRC4 is suitable for less than 40 kCal/sqcm.

3) Purchasing / Fabrication of & ensure Using Tethering Belt for carrying Hand tools. A tethering Belt provision will prevent the tool falling down into a Panel Bus bar area, and can protect against serious injuries, damage to property or loss.

Tethered tools are secured by a tool lanyard to an anchoring point, which is either a secure part of the worksite or the worker using the tool.

Provision of Acrylic Shredding Sheet in front of Panel Bus Bars. There are some Power panels in O&M site, which are not having a resistive shredding to separate the bus bars. By identifying them and introducing Acrylic Shredding in front of the Bus bars is highly recommended. However, this would be implemented during AMC schedule.

4.2 Implementation of Control Measures recommended against Electric Shock

Even though the existing control measures are well established and good enough, we recommended the following additional measures to strengthen the Safety against the hazard Electric Shock.

1. Ensuring LOTO usage with a Fail-proof system and through Inspections.

Lock Out and Tag Out system (LOTO) has been made mandatory before working in an electrical related activity.

A Safe Operating procedure has been derived and LOTO units have been purchased to regularize.

2. Insisting Prohibition of wearing Metal Ornaments like Earrings, Belt buckles, Body Jewelry.

Wearing Metal ornaments like Gold, silver or any other metal jewelries are strictly prohibited inside the site. By means sever

4.3 Implementation of Control Measures recommended against Mechanical Injury & Collisions

There are some Legal compliance requirements for this particular hazard control, and the same are under establishment especially for Collision hazard.

Considering the hazard 'Mechanical Injury', we recommended few additional control measures as this would cost a severe and critical risk while working such activities.

They are listed as below:

1. A suitable SSOW has to be developed and implemented for safer and proper DP tower climbing. A derived Safety procedure has been developed and made accessible to all workers.

2. Human factors related health issues have to be reviewed before engaging works at turbine by means of Tool Box talk before engaging in any such kind of works. This has been made into practice and routine.

al notifications, Alerts and Visual displays this has been established across the sites.

4.4 Implementation of Control Measures recommended against Mechanical Fall from Height

The following additional control measures have been recommended to the O&M Team for eradicating the Hazard 'Fall from Height' as it comes under critical hazard as a result of our HIRA practice.

1. Ensure Tower ladder rungs and working area free from grease / oil and utilisation of PPEs.
2. Providing safe working platform with guardrails, toe boards, Double lanyard Safety Harness. Etc. Wearing a double Lanyard Full body harness and anchoring the lanyard in appropriate anchoring point will save the lives perfectly.
3. Developing & Using Safe Systems of Work (SSOWs) to control Height access.

Like the above recommendations, We delivered a written statement to the SEI Cleantech Pvt Ltd, about the Risks that we identified, prioritized based on Risk Matrix as well as Risk Priority Number, and the Additional control measures that they can implement to obtain a healthier, stronger and effective Health and Safety management system as an output of our Project.

V. CONCLUSION

Here, I have come to the end of the project – phase 1 on the topic “Hazard Identification & Risk Assessment of a 100 MW Solar Power Plant”.

In this paper we observe present scenario of existing safety measures and its efficiency. The risk rating of the present and possible hazard is evaluated which divide them into acceptable, tolerable and unacceptable risk level in risks which are in unacceptable level, there possible corrective action also recommended to improve safety measure and analysis. The results of this analysis will be of valuable to find out the consequence on emergency situation that may occur.

With this knowledge, the level of preparedness can be assessed and measures taken to enhance capabilities through training and preparation of a more effective response to such occurrences.

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